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Indian Standard

SPECIFICATION FOR ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION

PART 1 GENERAL REQUIREMENTS

Section 3 High Frequency Disturbance Test for Static Relays

(First Revision)

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SPECIFICATION FOR ELECTRICAL RELAYS FOR POWER SYSTEM PROTECTION

PART 1 GENERAL REQUIREMENTS

Section 3 High Frequency Disturbance Test for Static Relays

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) (Part 1/Sec 3) was adopted by the Indian Standards Institution on 26 November 1986, after the draft finalized by the Relays Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The high frequency disturbance test is applicable to static relays only. This test determines whether a relay operates in a faulty manner when high frequency transients present in the system reach the fully energized relay.

0.3 The additional requirements of static protective relays were at first covered in IS : 8686-1977*, whereas IS : 3231-1965 covered 'electrical relays for power system protection'. While revising IS : 3231, it was decided to bring out the details of the high frequency disturbance test as a part of the revised series. Other details given in IS : 8686-1977* are also being covered in other parts/sections of the revised IS : 3231 and, as such, it is intended to ultimately withdraw IS : 8686-1977*.

0.4 According to the classification on hierarchical basis [*see* IS : 3231 (Part 0)-1986†], this standard is a first level document.

0.5 In preparing this standard, assistance has been derived from the following publications:

IEC Pub 255-4(1976) Single input energizing quantity measuring relays with dependant specified time. International Electrotechnical Commission (IEC).

*Specification for static protective relays.

†Specification for electrical relays for power system protection: Part 0 General introduction and list of parts.

BS 142 : Section 1.4 : 1983 Electrical protection relays; Part 1 Information and requirements for all protective relays, Section 1.4 Specification for the high frequency disturbance test for static relays. British Standards Institution.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part 1/Sec 3) covers the test method and criteria for acceptance for high frequency disturbance test applied on static relays used in power system protection.

2. TERMINOLOGY

2.1 For the purpose of this standard, definitions given in IS : 1885 (Part 9)-1986† shall apply.

3. GENERAL

3.1 High frequency disturbance tests are made in order to determine whether a relay will operate in a faulty manner when specified high frequency transients which are representative of practical system conditions are applied to fully energized relay.

NOTE — One frequency is considered to be justified as a test to be applied to all relays irrespective of design and gives a basic indication of the ability of the relay to withstand high frequency disturbances. Other test frequencies and other types of tests may be proved necessary in future and those will be added as experience is gained.

4. TEST CIRCUIT CONDITIONS

4.1 Waveform — A damped oscillatory wave with the envelope decaying to 50 percent of peak value at the end of 3 to 6 cycles.

4.2 Frequency — 1 MHz with a tolerance of $\pm$ 10 percent.

4.3 Source Impedance — 200 ohms with a tolerance of $\pm$ 10 percent.

4.4 Repetition Rate — The test wave shall be applied to the relay under test at a repetitive rate of 400 per second.

*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary: Part 9 Electrical relays (*first revision*).

4.5 Duration of Test — 2 seconds with a tolerance of $^{+10}_{-0}$ percent (*see* Note under **5.7**).

4.6 Value of Test Voltage — The value of test voltage for the appropriate class when measured at the output of test circuit before the relay to be tested is connected to the test circuit terminals shall be as follows:

a) *Class I*	
Test voltage	0 V (no test)
b) *Class II*	
i) Longitudinal mode	1 kV peak value of first half cycle
ii) Transverse mode	0·5 kV peak value of the first half cycle
c) *Class III*	
i) Longitudinal mode	2·5 kV peak value of first half cycle
ii) Transverse mode	1 kV peak value of first half cycle
Test voltage tolerance	$^{+0}_{-10}$ percent

Guidance on the relay applications for which the above test voltage classes are appropriate is given in Appendix A.

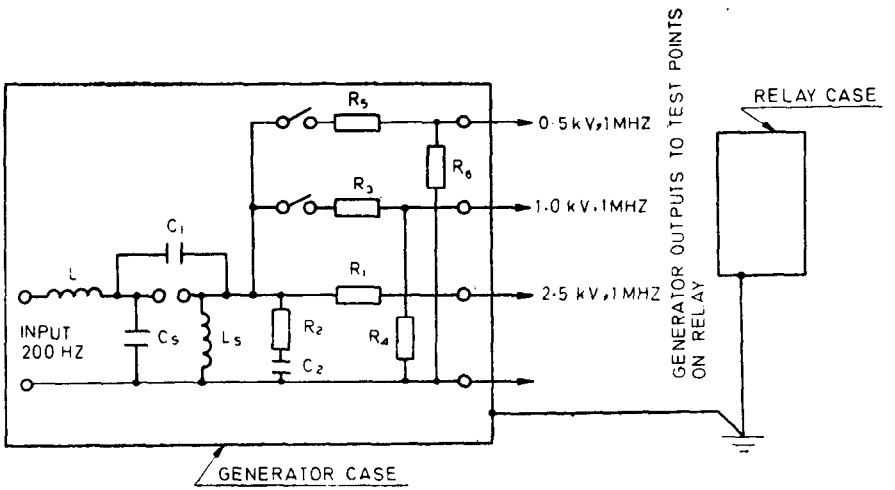
4.7 Impulse Generator Circuit — The recommended standard test circuits are shown in Fig. 1, 2 and 3.

4.8 Test Leads — The test leads shall not be longer than 2 m.

5. TEST PROCEDURE

5.1 Disturbance test shall be regarded as type test only.

5.2 The test shall be carried out with the relay under reference conditions as given in individual relay specification.

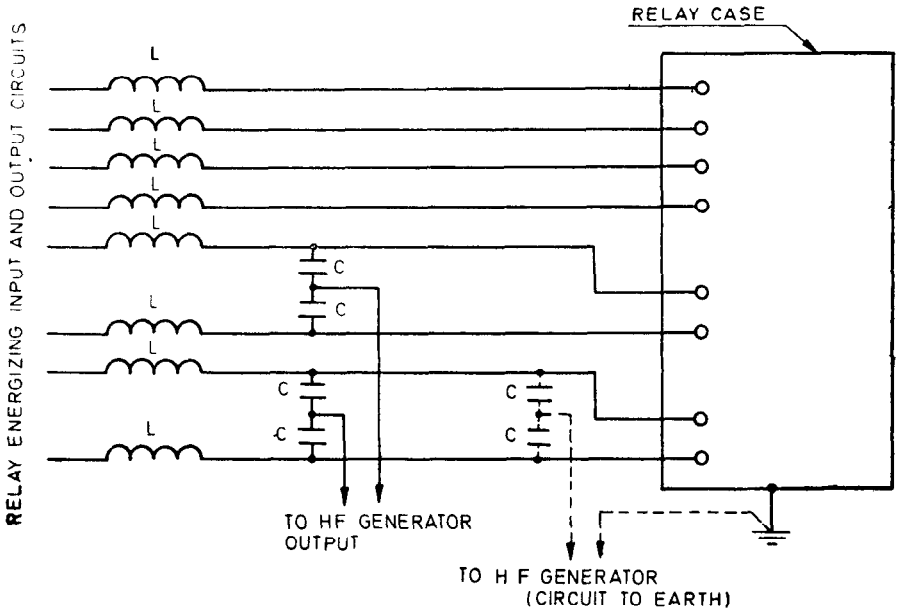


L	= 26 μH	R_2	= 100 Ω
C_1	= 20 nF	R_3	= 500 Ω
L_S	= 6·3 μH	R_4	= 333·3 Ω
C_S	= 4 nF	R_5	= 1 000 Ω
C_2	= 80 PF	P_6	= 250 Ω
R_1	= 200 Ω		

NOTE 1 — The U.H.F. Filter R_2 C_2 is optional as determined by experiment.

NOTE 2 — If oscilloscope is connected in circuit for checking output parametres it should be switched out of circuit when applying test to the relay for safety reasons.

FIG. 1 CIRCUIT FOR DAMPED OSCILLATORY WAVE GENERATOR

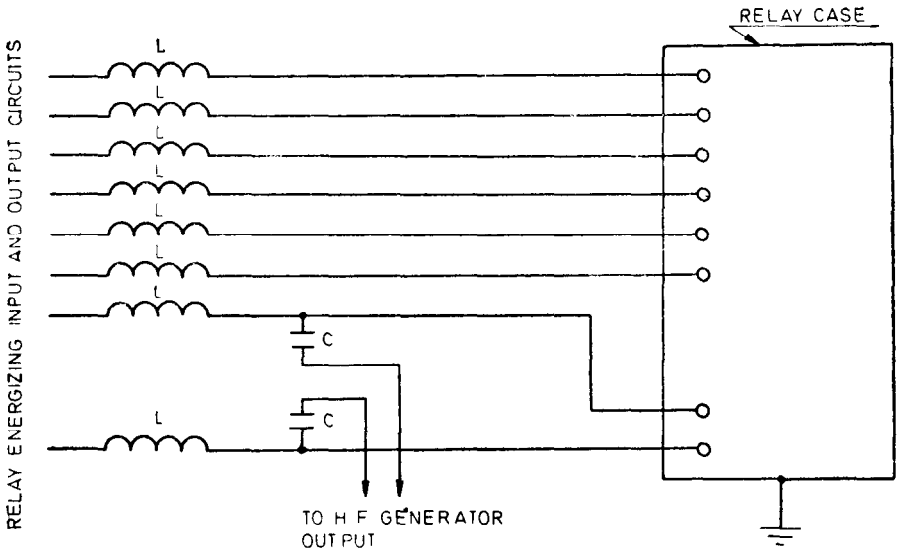


L = 1·5 mH (between circuits)
C = 0·5 μF

FIG. 2 COUPLING CIRCUIT FOR HF DISTURBANCE TEST — LONGITUDINAL MODE

5.3 The test shall be carried out with the following values of energizing quantities (auxiliary and input) and loading applied to the appropriate circuit:

a) Auxiliary energizing quantity(ies)	Rated value(s)	
b) Input energizing quantity(ies)	i) For all or nothing relays	Zero and rated values
	ii) For measuring relays	Rated value where appropriate (for example, frequency relays) or value(s) corresponding to the setting values of the characteristic quantity as specified
c) Output circuit loading	Circuit characteristic as specified by the manufacturer	



C = 0·5 μF
L = 1·5 mH

FIG. 3 COUPLING CIRCUIT FOR HF DISTURBANCE TEST — TRANSVERSE MODE

5.4 On measuring relays, the test shall be carried out at below as well as above the operating value of the characteristic quantity.

5.5 The relay shall be tested in its case with the cover in position; all parts designed to be earthed shall be earthed. The test voltage shall be applied between appropriate points accessible from outside the case, as follows:

a) Between each independent circuit and earth;

b) Between each pair of independent circuits of the relay; and

c) Between terminals of the same circuit, where applicable.

5.5.1 Test as given in **5.5**(c) is not applicable to metallic contact circuits, but shall be applied to all other types of output circuits. In these cases, the output circuit loading shall correspond to the worst case condition as specified by the manufacturer, but it is normally resistive.

5.5.2 Where energizing circuits (input and auxiliary) and output circuits of different test voltage classes are present on the same relay, test given in **5.5**(c) is carried out at the assigned class voltage of the circuit. All other tests are carried out at the highest class voltage assigned to any circuit within the relay.

5.6 The test shall be applied and the effects checked, across one set of test points at the same time.

5.7 The test shall be carried out for a period of two seconds except for relays with an operating time greater than 2 seconds.

NOTE — It is recommended that the test be carried out with a time setting nearest to two seconds. Where the minimum time setting is greater than two seconds it may be convenient to extend the period of application of the disturbing signal to cover this minimum time.

5.8 The variation due to the effect of the disturbance test shall be declared by the manufacturer.

6. CRITERIA FOR ACCEPTANCE

6.1 When the characteristic quantity is set at a value equal to the claimed variation below the operating value of the characteristic quantity, the relay shall not operate during the disturbing period.

6.2 When the characteristic quantity is set at a value equal to the claimed variation above the operating value of the characteristic quantity, the relay shall comply with the declared performance specification and shall not disengage during the disturbing period.

6.3 After the tests, the relay shall still comply with all relevant performance requirements given in individual relay specification.

6.4 For static relays without output contacts, off-state current in the output circuit shall not exceed the value declared by the manufacturer when measured at 110 percent of the rated voltage for that circuit.

NOTE — Depending on the nature of the output circuits, the manufacturer may declare other quantities or criteria which adequately identify possible changes in the output due to the tests.

APPENDIX A

(*Clause* 4.6)

SELECTION OF TEST VOLTAGE CLASS

A-1. The test severity class should be chosen such that the expected level of disturbance voltage does not exceed the test voltage of the class chosen.

NOTE — A relay or equipment may have different test severity classes for its input energizing circuits, auxiliary energizing circuits and output circuits.

A-2. The examples in **A-2.1** to **A-2.3** give guidance for the selection of the appropriate test severity class.

A-2.1 *Class I* — Test Voltage 0 V (no test) — Relays and equipment in this class are used in an environment without disturbance voltages.

A-2.2 *Class II* — Relays and equipment in this class may be used where:

a) the auxiliary energizing circuits (power supply circuits) of the relay or equipment are connected to a voltage supply used exclusively for the power supply of static equipment, the leads are short, and there is no switching on other circuits connected to the supply;

b) the input energizing circuits of the relays are not connected directly to current transformers and/or voltage transformers or where good screening and earthing is employed on the connecting leads;

c) the output circuits are connected to a load by short leads; and

d) normally no disturbance test is required but a higher degree of security is wanted.

A-2.3 *Class III* — Relays or equipment in this class may be used where:

a) the auxiliary energizing circuits (power supply circuits) of the relay or equipment are connected to station batteries, etc, which are not used exclusively for the power supply of static equipment.

Due to long leads, common and differential mode disturbance voltages of relatively high value may appear on the supply leads, arising from switching in other circuits connected to the same battery or supply source;

b) the input energizing circuits of the relay are connected to current transformers and/or voltage transformers and/or where long leads are involved and no effective screening and earthing is employed;

c) the output circuits are connected to a load by long leads in such a way that common and differential mode voltages of relatively high value appear at the output terminals, caused, for example, by the electromagnetic field and/or the unbalance with respect to earth; and

d) normally, a lower test voltage in terms of **A-2.2**(a) and **A-2.2**(b) for class II above as sufficient but an extra-high degree of security is required.

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